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Period Parity Progression Ratios and Birth Intervals in England and Wales, 1941–1971: A Synthetic Life Table Analysis*

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1. INTRODUCTION

For tracking temporal change in fertility, period indices of 'level' – e.g. total fertility – are known to have the disadvantage that they are subject to much larger short-term fluctuations than is displayed by the completed fertility of the cohorts passing through the childbearing ages during a given period. In so far as a composite index such as total fertility is required to measure the volume of current fertility in some sense, and that the purpose of observing time trends is to make statements about the path of change in fertility, period measures give an unreal indication of the true extent of temporal change. A particular difficulty is that alterations in the tempo of reproduction may inflate or deflate period indices which are apparently measuring the 'quantum' of fertility. Ryder has written extensively on this problem.[1]

Some of the limitations of period analysis may be ascribed not so much to inherent weaknesses in the period approach as to the absence from the traditionally used vital registration sources of data and tabulations by means of which period measurement could be refined. In particular, detailed analysis by order of birth and parity of woman is often not possible with standard registration data, both because population denominators are frequently not available for parity groups and because date of previous birth, from which length of interval may be calculated, is only rarely collected at birth registration. The merits of an order-specific approach to period fertility[2] were recognized

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[1] See, e.g. N. B. Ryder, 'Components of temporal variations in American fertility', in R. Hiorns (ed.), *Demographic Patterns in Developed Societies* (London, 1980), pp. 15–54; N. B. Ryder, *Progressive Fertility Analysis*, WFS Technical Bulletin No. 8 (London, 1982).

[2] A. Lotka and M. Spiegelman, 'The trend of the birth rate by age of mother and order of birth', *Journal of the American Statistical Association*, **35** (1940), pp. 595–601; V. L. Galbraith and Dorothy S. Thomas, 'Birth rates and the interwar business cycles', *Journal of the American Statistical Association*, **36** (1941), pp. 465–476; P. K. Whelpton, 'Reproduction rates adjusted for age, parity, fecundity and marriage', *Journal of the American Statistical Association*, **41** (1946), pp. 501–516; J. Hajnal, 'The analysis of birth statistics in the light of the recent international recovery of the birth rate', *Population Studies*, **1** (1947), pp. 137–164; G. J. Stolnitz and N. B. Ryder, 'Recent discussion of the net reproduction rate', *Population Index*, **15** (1949), pp. 114–128; J. Hajnal, 'Births, marriages and reproductivity, England and Wales, 1938–1947', *Papers of the Royal Commission on Population, Vol. ii, Reports and Selected Papers of the Statistics Committee* (London, 1950); N. B. Ryder, *The Cohort Approach: Essays in the Measurement of Temporal Variations in Demographic Behavior* (Princeton, 1951, Ph.D. Dissertation; published New York, 1980); L. Henry, *Fertility of Marriage: a New Method of Measurement* (Paris, 1953; English translation, 1980, UN/ESCAP Population Studies Translation Series No. 3); P. K. Whelpton, *Cohort Fertility* (Princeton, 1954).

early but the subject has been little explored until recently in the English-language literature, possibly because of the absence of suitable data.[3]

In developing and applying the parity progression approach to the measurement of period fertility Henry[4] proposed, in order to overcome the lack of complete data, two methods for the indirect estimation of period parity progression ratios. More recently, Frinking and also Marchal and Rabut have applied Henry's indirect measures to generate time series of period parity progression ratios for a number of European countries.[5] An indirect method due to Brass has been applied by Pellizzi and by Penhale to data from Italy and France, respectively. Feeney has made extensive contributions to the recent development of the parity progression perspective in temporal analysis[6] and reports a life-table formulation of the period parity progression ratio which is effectively identical to the one given here and was proposed independently.[7]

2. MEASUREMENT ISSUES

Before describing the method presented and applied in this paper, we shall discuss three aspects of the methodological issues surrounding the measurement of period fertility, namely (*a*) formal issues of measurement; (*b*) substantive considerations with a bearing on measurement; and (*c*) practicalities.

(A) *Formal issues of measurement*

A satisfactory measurement of fertility for a period, t, should be capable of being compared meaningfully with that for some other time t' and the difference between them should reflect, as far as possible, a difference in the level of fertility at those two points in time. A measure of fertility in t should represent the propensity to bear children during t and during t alone. Various standardizing procedures are available to remove from the period fertility index differences between years caused by the effects of 'nuisance' factors such as age structure which may be strongly associated with birth propensities. The need for such standardization arises from the fact that populations are, in practice, not stable in structure. A further objective of adjusting for compositional factors is to produce measures that represent fertility in the current year with the influence of past fertility removed as far as possible. In discussing the construction of fertility indices Ryder[8] describes the 'process of further specificity of occurrence/exposure rates' as yielding

[3] See, however, H. S. Shryock and J. S. Siegel, *The Methods and Materials of Demography* (Washington, US Bureau of the Census, 1973), pp. 789–791; C. B. Park, 'Lifetime probability of additional births by age and parity for American women, 1935–1968: a new measurement of period fertility', *Demography*, **13** (1976), pp. 1–17; and L. Isaac, P. Cutright, E. Jackson and W. R. Kelly, 'Period effects of race- and parity-specific birth probabilities of American women, 1917–1976: a new measure of fertility', *Social Science Research*, **11** (1982), pp. 176–200.

[4] *Op.cit.* in footnote 2.

[5] F. Marchal and O. Rabut, 'Evolution récente de la fécondité en Europe occidentale', *Population*, **27** (1972), pp. 838–874; G. Frinking, *Rapport sur les tendances récentes et futures de la fécondité en Europe occidentale* (Council of Europe, 1976); see also INED, 13[e] Rapport sur la situation démographique de la France, *Population*, **39** (1984), pp. 669–732 and previous years in this series.

[6] G. Feeney, 'Population dynamics based on birth intervals and parity progression', *Population Studies*, **37** (1983), pp. 75–89; G. Feeney, 'Parity progression measurement of fertility trends'. Paper presented at the Tenth Population Conference, East–West Population Institute, Honolulu, 1985; G. Feeney & Jingyuan Yu, 'Period parity progression measures of fertility in China'. *Population Studies* **41** (1), 1987, pp. 77–102.

[7] G. Feeney and M. Wijeyesekera, 'Parity progression and birth interval analysis in South Asia'. Paper presented at the Conference on Recent Population Trends in South Asia, New Delhi, February 1983; G. Feeney, 'Parity progression projection', *Proceedings of the IUSSP International Population Conference*, Florence, vol. 4, pp. 125–134 (Liège, 1985).

[8] N. B. Ryder, 'Fertility measurement through cross-sectional surveys', *Social Forces*, **54** (1975), pp. 7–35.

'products which draw ever finer distinctions between current behaviour and the residue of past behaviour reflected in the exposure distribution at any time'. The introduction of a control for parity is particularly directed to this end. The argument for such a control rests on the observations[9] (*a*) that in a contracepting population some idea of desired family size may be thought to govern reproductive behaviour; (*b*) that reproduction, therefore, depends on parity, and thus on the past reproductive performance of individuals at risk at any given time; (*c*) that desired family size may change both up and down; and (*d*) that in the absence of stability the composition of the population at risk with respect to parity will vary from year to year. A further argument is that even if desires for and ultimate actual family size were constant across cohorts, delays caused by deferred marriage or use of contraception within marriage may alter the parity composition of the population from year to year. Very similar considerations lead to the introduction of length of interval as a further standardizing factor. Because the probability of an additional birth is strongly associated with the time elapsed since the previous birth, the size and composition of a population of women of a given parity with respect to time elapsed since previous birth will vary from year to year due to previous movements into a parity group and in duration-specific rates of movement out of it. In sum, allowance for parity and length of birth interval improves, in Ryder's[10] terminology, the contemporaneity of measurement.

(B) *Substantive considerations with a bearing on measurement*

A further argument for parity-specific measures of period fertility is that it is desirable to specify indices of a kind that are appropriate to use as dependent variables in models that aim to account for movements in fertility over time.[11] Early interest in order-specific birth rates was based on the view that period variations in socio-economic conditions affect fertility differentially by order of birth. The likelihood that socio-economic factors influence reproductive performance at the individual level in an order-specific way has also long been recognized in micro-demographic discussions of how to improve explanatory inquiry.[12] In general, family building is a sequential process, and there is evidence that the factors affecting the probability of having an additional birth vary with birth order.[13] This is explicitly recognized by incorporating parity-specificity into fertility measurement.

(C) *Practicalities*

The greater availability of maternity history data during the past decade has led to a revival of interest in the analysis of fertility by order of birth. Maternity histories – subject

[9] See, e.g. Henry, *op. cit.* in footnote 2 and Whelpton, *op cit.* in footnote 2.

[10] See Ryder, 1980, *loc. cit.* in footnote 1.

[11] See Ryder, 1980, *loc. cit.* in footnote 1 and Isaac *et al., loc. cit.* in footnote 3.

[12] E. G. Mishler and C. F. Westoff, 'A proposal for research on social psychological factors affecting fertility: concepts and hypotheses', in Milbank Memorial Fund *Current Research in Human Fertility* (New York, 1955); N. K. Namboodiri, 'Some observations on the economic framework for fertility analysis', *Population Studies*, **26** (1972), pp. 185–206.

[13] C. F. Westoff, R. G. Potter, P. C. Sagi and E. G. Mishler, *Family Growth in Metropolitan America* (Princeton, 1961); Eva M. Bernhardt, 'Fertility and economic status – some recent findings on differentials in Sweden', *Population Studies*, **26** (1972), pp. 175–184; N. K. Namboodiri, 'Which couples at given parities expect to have additional births?', *Demography*, **11** (1974), pp. 45–56; J. L. Simon, 'The mixed effect of income on successive births may explain the convergence phenomenon', *Population Studies*, **29** (1975), pp. 109–122; M. Hout, 'The determinants of marital fertility in the United States, 1968–1970', *Demography*, **15** (1978), pp. 139–159; M. J. Murphy, 'The association between socio-economic and related factors on family formation and breakdown: some evidence from a British National Survey', LSHTM CPS Research Paper No. 84–2; E. de Cooman, J. Ermisch and H. Joshi, 'The next birth and the labour market: a dynamic model of births in England and Wales', *Population Studies*, 1987 (forthcoming).

only to the restricted coverage imposed by an upper age limit – provide full information for both individual and for aggregate level analysis.

The typical fertility survey is cross-sectional by age, and observation is truncated by interview date. This leads naturally to the use of a life-table approach to the analysis of birth intervals. In deploying maternity histories to study fertility trends by means of life-table estimates of parity progression, three temporal frameworks may be adopted. The passage of calendar time may be represented in series of (i) age (or marriage) cohorts, (ii) true parity cohorts or (iii) synthetic parity cohorts. Each of these designs has distinctive advantages and disadvantages.[14]

(i) *Age or marriage cohort design.* The use of an age or marriage cohort framework has the advantage that the parity progression ratios obtained relate to the experience of groups of real women. Also, the progression ratios for each birth order refer to the same base population, and so it is possible to reconstruct, subject only to the constraints of the upper age limits, true sequences across orders of birth, and this represents the family formation process of actual groups. Against these points is the disadvantage that levels of progression in more recent times are difficult or impossible to estimate, both because they are upwardly biased (young women or those of short marriage duration who have reached a given order of birth are selected for fast progression, and thus for higher fertility) and because they are imprecise (in the conventional fertility survey the numbers at risk will be small). Each of these two problems increases in severity with increasing order of birth. Parity progression ratios of higher order are thus impossible to estimate for recent times. While the second problem is insurmountable, age selectivity can be adjusted for in a variety of ways.[15]

(ii) *True parity cohorts.* In the true parity cohort approach, births of a given order occurring in a specified period are followed.[16] In a parity progression context this design shares with the age or marriage cohort format the advantage of representing within each progression an actual sequence of exposure and events, but gives a rather more fragmented account of family construction in that the progression ratios for different orders of birth, while each representing a true sequence, cannot be combined to match any underlying population. Selectivity for young age, together with diminished sample sizes occurs during periods more distant from interview but these can be handled fairly straightforwardly.[17] Because the most recent true parity cohorts are observed for only a short time, their behaviour cannot be assessed, and the longer the duration chosen for evaluating the progression ratio, the more cohorts are affected. This demerit is not, however, related to birth order. An attraction of this approach is that the true parity cohort is a kind of compromise between classic age or marriage cohort analysis on the one hand, and period analysis on the other, since the progression to the next birth is

[14] For discussion of some of the methodological issues arising in the life-table analysis of birth intervals from maternity history data see G. Rodriguez and J. Hobcraft, *Life table analysis of birth intervals in Columbia: an illustrative analysis*, WFS Scientific Report No. 16 (London, 1980); W. Brass, 'Birth history analysis', *Proceedings of the World Fertility Survey Conference 1980*, vol. 3, pp. 137–178; R. R. Rindfuss, J. A. Palmore and L. L. Bumpass, 'Selectivity and the analysis of birth intervals from survey data', *Asian and Pacific Census Forum*, **8** (1982), pp. 5–10, 15, 16; N. B. Ryder, *Progressive Fertility Analysis*, WFS Technical Bulletin No. 8 (London, 1982); G. Feeney, 1983, *loc. cit.* in footnote 2; W. Brass and F. Juarez, 'Censored cohort parity progression ratios from birth histories', *Asian and Pacific Census Forum*, **10** (1983), pp. 5–13.

[15] Rodriguez and Hobcraft, 1980, *op. cit.* in footnote 14; Brass and Juarez, 1983, *loc. cit.* in footnote 14.

[16] This is used in Rodriguez and Hobcraft, 1980, *op. cit.* in footnote 14, and R. R. Rindfuss, L. L. Bumpass, J. A. Palmore and D. W. Han, 'The transformation of Korean child-spacing practices' *Population Studies*, **36** (1982), pp. 87–104. The true parity cohort concept originated with Henry and is described in relation to vital registration data in chapter 5 of G. J. Wunsch and M. G. Termote, *Introduction to Demographic Analysis* (London, 1978).

[17] Rindfuss *et al.*, 1982, *loc. cit.* in footnote 12.

generally fairly rapid and the parity cohort's experience is thus confined to a relatively short stretch of time.

(iii) *Synthetic parity cohorts.* Finally, the synthetic parity cohort approach to parity progression is, as regards practical costs and benefits, an inverse mirror image of the age or marriage cohort design. In this, the family formation process is completely fractionated. The parity- and duration-specific rates obtaining in a period are assumed to apply to a group of women who become exposed to the risk of a birth of specified order, and the numerical consequences of this imaginary concatenation of experience used to represent the period level. The quantities calculated for a synthetic parity cohort do not represent the sequential experience of any one group of women. But they are likely to differ less from the corresponding values of the constituent true parity or age cohorts at risk around that period than do indices constructed on a fictitious age cohort basis. This is because the progression from one birth to the next is a fairly fast process, and so the progression ratios estimated for a given period are a synthesis over a fairly short span of reproductive time.[18] Like the true parity cohort design, study of trends by means of hypothetical parity cohorts encounters progressive selection for young age in periods more distant from interview.[19] This problem can be surmounted in the same way as in the true parity cohort approach, by imposing, during analysis, an upper age limit over all periods corresponding to that applying in the earliest period chosen for analysis. Probably the most important point in favour of the synthetic parity cohort – and that which distinguishes it from the age and true parity cohort designs – is that it is as up to date as the interview itself. The period immediately preceding survey date (or last observation) is that for which fullest information is available. In particular, current estimates of birth intervals may be obtained.

To summarize, the attractions of this method of analyzing time trends include: (*a*) it enables data for the most recent period to be efficiently used; (*b*) it has the merit that age selectivity and small base numbers are encountered during time periods distant from, rather than close to the date of the survey; (*c*) it provides a more refined perspective on fertility trends than the use of measures of cumulative births or total fertility, and makes it possible to examine differences in trends by order of birth; (*d*) the rates used are based on the correct population at risk; (*e*) quasi-independent measures of quantum and tempo may be obtained for calendar periods in life-tables estimates of progression and of median intervals; (*f*) the variety of measures derivable from the period life table might well form the basis for further exploration of period fertility as dependent variable; (*g*) the parity- and duration-specific rates that form the basis of the synthetic life table are possibly closer to the elements of fertility behaviour that are pivotal from the point of view of the social underpinnings of the behavioural process involved; the combination of parity and time since last birth is not only a bio-demographic quantity but also a feature of the qualitative situation of women and families; (*h*) as an approach to period measurement, it has the

[18] It will be seen later that in the synthetic life-table results for 1950–70/1, of women who had a further birth within ten years of the preceding birth (or marriage, in the case of first birth), half did so within 1.5–3 years, and the upper quartiles are in the range 3–5.5 years. In contrast, the median and upper quartile of the age-specific fertility schedule in 1970 occurred at ages 26 and 31, respectively, representing a duration of 10 and 15 years since the start of exposure to risk of marriage and giving birth at age 16. The conventional total fertility calculation thus incorporates assumptions about rates obtaining at times much more distant from the current time point than does the synthetic parity cohort. This being so, the hypothesis involved in the computation of synthetic parity cohort rates is likely to be more realistic.

[19] The nature of the age selection effect is slightly different in the synthetic than in the true parity cohort design. In the true parity cohort, there is a straightforward selection for young age at *entry* into interval in earlier periods. In the synthetic parity cohort there is selectivity for young age among those *still exposed* at durations from 0 to 120 months in a specific period. This being so, there could, in principle, be selection for slow progression among young women still exposed at long durations to counterbalance overrepresentation of highly fertile women at earlier durations.

property of controlling to a larger extent than other measurement methods for the quantum and tempo of past reproductive performance.

3. METHOD

The method used here is essentially a life-table formulation of the period parity progression ratio specified by Henry and has also been developed independently by Feeney.[20] In a period t which, for the sake of exposition, may be considered to be just one month long, let $B(i,x,t)$ represent births of order i occurring during t at x months since the previous birth. Altogether there are in t $\Sigma B(i,x,t)$ births of order i. The $q(i,x,t)$ of the period life table are then defined as

$$q(i,x,t) = \frac{B(i,x,t)}{\sum_{y=1}^{m} N(i-1,y,t-x) - \sum_{y=1}^{x-1} N(i,y,t\text{-}x+y)},$$

where $N(i,j,k)$ is the number of women having an ith birth at duration j in period k; m the maximum duration at which births occur and where the second or later in a set of multiple births is considered to occur at duration one month. The values of $q(i,x,t)$ may, by extension, be readily obtained for periods longer than one month. For a period t^* lasting from month t_1 to month t_2, they are then

$$q(i,x,t^*) = \frac{B(i,x,t^*)}{\sum_{t'=t_1}^{t_2} \sum_{y=1}^{m} N(i-1,y,t'-x) - \sum_{t'=t_1}^{t_2} \sum_{y=1}^{x-1} N(i,y,t'-x+y)}$$

where $B(i,x,\mathrm{t}^*)$ stands for births of order i occurring during the period t_1 to t_2 at duration x months since previous birth and $N(i-1,y,t'-x)$ is the number of women who have a birth of order $i-1$ at duration y in month $t'-x$. The period t_1 to t_2 may, for example, span a calendar year or a series of calendar years, depending on the size of the data set and the refinement required in analysis. The life table could also be specified in abridged form, e.g. Feeney's[21] computation of the period parity progression ratio uses a duration index measured in years rather than months, as given here. For the first birth, duration is measured from date of marriage. Except in the calculation of the parity-progression-based total fertility described later in Section 5E illegitimate births are ignored. A marriage progression is also obtained here and consists of the same calculation as for the progression to each order of birth, but with duration measured in months since 16th birthday. This is an exactly computed version of the conventional gross nuptiality table.

4. DATA AND ANALYSIS

The data analyzed here are taken from a sample of a one per cent of single and ever married women in the census of England and Wales of 1971. Dates of first marriage and of all subsequent live births were collected for women aged 16–59 at census date. The data relate to 122,644 single and ever-married women (marriage tables) and 102,547 ever-married women (birth interval tables). A breakdown of omitted cases is given in the Appendix. The analysis follows the methodological principles outlined by Rodriguez and Hobcraft[22] with some variations in detail. The parity progression ratio is evaluated as the proportion of women who go on to have an additional birth within ten years and

[20] Henry, 1953, *op. cit.* in footnote 2; Feeney and Wijeyesekera, 1983, *loc. cit.* in footnote 6; Feeney, 1985, *loc. cit.* in footnote 6.

[21] Feeney, 1985, *loc. cit.* in footnote 6.

[22] Rodriguez and Hobcraft, 1980, *op. cit.* in footnote 12.

the calculation of median time to next birth is correspondingly confined to those progressing within ten years.[23] Progression ratios up to the sixth birth order were examined in the present study. Multiple births are identified separately and births recorded as second or later in a multiple birth event are treated as having occurred at duration one month. The records are truncated at a woman's 45th birthday, no exposure or events being entered for any period after that date. Some analyses are presented of the ${}_nq(i, x, t)$ values – the period estimate of the conditional probability of a birth of order i occurring during the interval x to $x+n$ months after the start of the interval. The parity progression ratios are also used to obtain estimates of a period total fertility index using the formula

$$\sum_{j=0,5} \prod_{i=0,j} a_{it}$$

which may be considered an alternative to the conventional age-specific computation. Finally, the contribution of changes in each of the progression ratios to the period variation in this alternative total fertility measure is examined

Results are presented on an annual basis, but since the Census of 1971 took place on 25 April, just under one-third of one year's observation is available for 1971, and for this reason 1970 and 1971 have been combined. The data are truncated with an upper age limit of 59 years in 1971 decreasing to 29 years in 1941. Thus, complete coverage of exposure and events is given for women who had not reached their 29th birthday in 1941, their 39th in 1951, or their 45th in or after 1957. From 1947 onwards, all women who had not reached their 35th birthday were covered. For the period 1951 to 1970/1 the standard errors of the annual progression ratios in absolute value are within the following ranges (percentages):

a_0: 0.5–0.8	a_3: 1.2–2.3;
a_1: 0.7–0.9	a_4: 1.9–3.4;
a_2: 0.9–1.4	a_5: 3.2–5.9.

In the tables and diagrams that follow, years before 1947 have been omitted for third and fourth births because of age selectivity. Results for a_4 are given for 1954 and later years, when the absolute standard errors were below three per cent. Due to a technical difficulty the dates of marriages occurring before January 1941 were not available to the present study. Because first births to these marriages cannot, therefore, be analyzed a full life table for up to ten years' duration can only be calculated from 1951 on for first births.

5. RESULTS

(A) *Period parity progression ratios*

The progression to first marriage by age 30, together with period parity progression ratios a_0–a_4 are given in Table 1 and plotted in Figure 1. Apart from the substantial war-time dip in 1943–4, the marriage progression is not especially variable, rising from 0.84 in 1945 to a peak of 0.92 in 1969. The beginning of the later sharp decline in marriage propensity then becomes evident in the drop of 0.86 in 1970/1. In the birth progressions, three types of movement are in evidence. (1) There is a fairly slow drift upwards in the annual estimate of the proportion proceeding from marriage to first birth from 0.83 in 1951 to a maximum of 0.92 in 1966, falling to 0.88 in 1970/1; the proportionate change in this ratio from 1951 to the peak year is ten per cent. (2) Substantially more marked

[23] The proportion of births of each order that take place more than ten years after the previous birth during 1956–70 in the present data exceeds five per cent in only a few instances. However, the proportion taking place more than five years after the previous birth is substantial enough to suggest an index of progression beyond the 'quintum' or B_{60} used by Rodriguez and Hobcraft.

Table 1. *Proportions married by age 30 and parity progression ratios England and Wales 1941–70/1*

Year	Marriage	a_0	a_1	a_2	a_3	a_4
1941	0.831	—	0.684	—	—	—
1942	0.827	—	0.712	—	—	—
1943	0.727	—	0.710	—	—	—
1944	0.725	—	0.780	0.733	—	—
1945	0.841	—	0.725	0.652	—	—
1946	0.857	—	0.820	0.717	—	—
1947	0.863	—	0.824	0.674	0.713	—
1948	0.872	—	0.763	0.617	0.626	—
1949	0.862	—	0.725	0.535	0.564	—
1950	0.873	—	0.677	0.505	0.549	—
1951	0.873	0.833	0.698	0.492	0.510	—
1952	0.862	0.843	0.677	0.491	0.529	—
1953	0.867	0.849	0.706	0.478	0.462	—
1954	0.874	0.844	0.708	0.479	0.472	0.585
1955	0.898	0.844	0.713	0.473	0.500	0.465
1956	0.894	0.857	0.758	0.495	0.463	0.551
1957	0.896	0.859	0.741	0.485	0.493	0.507
1958	0.900	0.874	0.769	0.526	0.493	0.499
1959	0.905	0.868	0.791	0.531	0.493	0.573
1960	0.915	0.877	0.812	0.538	0.537	0.579
1961	0.915	0.888	0.808	0.541	0.535	0.577
1962	0.906	0.902	0.808	0.539	0.526	0.555
1963	0.903	0.910	0.828	0.549	0.530	0.556
1964	0.903	0.913	0.850	0.574	0.564	0.542
1965	0.905	0.914	0.848	0.559	0.510	0.456
1966	0.917	0.916	0.844	0.523	0.471	0.483
1967	0.895	0.909	0.840	0.503	0.422	0.457
1968	0.919	0.909	0.853	0.494	0.409	0.472
1969	0.921	0.896	0.847	0.479	0.434	0.387
1970–71	0.864	0.883	0.819	0.463	0.385	0.357

movement during this period is shown by a_1, the progression from first to second birth. From a value of 0.73 in 1945, a_1 rises precipitously by ten percentage points in 1946, stays high in 1947 and falls back rapidly again reaching a low level of 0.68 in 1952, rising steadily thereafter to fluctuate around 0.85 in 1964–8 before declining to 0.82 in 1970/1. The relative increase in the peak year 1966 over 1951 is 26 per cent. Like the marriage and first-birth progression, the fall at the end of the 1960s is only moderate. (3) The middle progression ratios – to third or fourth birth – show a lesser increase from around 0.5 in 1951 to peak levels of 0.57 and 0.56 in 1964 and then fall very substantially to 0.46 and 0.39 respectively in 1970/1. The proportionate rise in these ratios to their peak in 1964 is respectively 14 per cent and 11 per cent over 1951 values.

Some further points are of interest here. First, both the total fertility based on summing age-specific birth rates and all age-specific fertility rates, with the exception of the extreme age groups 15–19 and 40+, reach a maximum over this period in 1964, and in general the rise and fall of the age-specific fertility rates across age groups is fairly synchronous. The period parity progression ratios given here do not show the same tendency and suggest that 1964 was not indisputably the peak year of the fertility upswing; only a_2 and a_3 show a definite peak in 1964, a_1 reaching 0.85 in 1964, but again in 1968, and a_0 continuing to rise (to 0.92) to 1966. Secondly, the time series of progression ratios of different orders are themselves not completely synchronous. Their movements are broadly similar but cross-correlation analysis reveals that although the series a_0 to a_3,

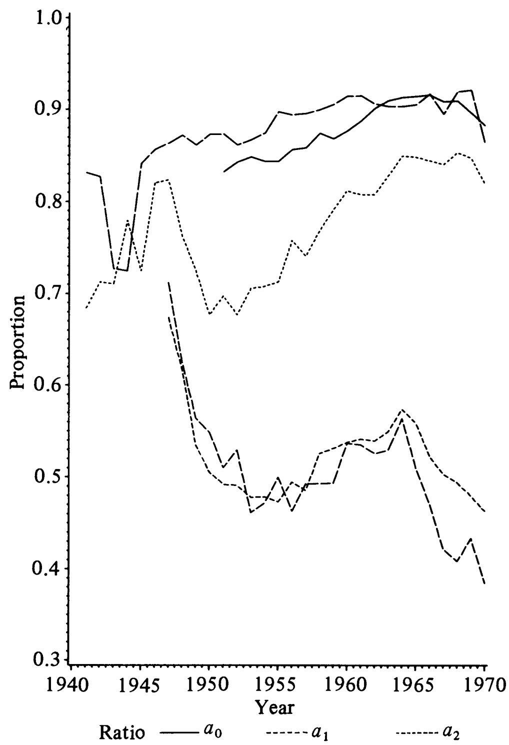

Figure 1. Marriage and parity progression ratios, England 1941–1970/1.

when differenced, tend to show a maximum correlation over the years 1952 to 1970/1 at a lag of zero; the correlations are not especially high (between 0.33 and 0.66). Disaggregated in this way fertility series in England and Wales during the 1950s and 1960s display little of the 'cosmic' uniformity of movement sometimes noted in relation to age-specific fertility rates.[24]

(B) *Conditional probabilities of transition*

Series of conditional values of ${}_nq_x$ are given in Figure 2(A–C) for first to third births. The indices plotted are ${}_8q_0$, ${}_9q_9$, ${}_{12}q_{18}$, ${}_{12}q_{30}$, ${}_{12}q_{42}$ and an average of the five values of ${}_{12}q_x$ from 4.5 to 9.5 years for first birth; for second and third births the plots are of twelve-monthly intervals up to duration 60, together with an average of the yearly transition rates between 60 and 120 months. These series are fairly uneven in appearance, but nevertheless some broad features are discernible. First, there is a substantial surge in the probability of first birth at durations up to 54 months in 1947 (values at later durations being unavailable), the peak year of the post-war bulge, and these decline gradually again over the succeeding 3–4 years. Secondly, in 1947 the rise in the probability of first birth at durations below nine months was modest relative to other durations, a feature that may be due to the war's aftermath having resulted in a contraction in the exposure to (maritally oriented) pre-marital conception.[25] Thirdly,

[24] See, e.g. R. R. Rindfuss and J. A. Sweet, 'The pervasiveness of post-war fertility trends in the United States', chapter 2 in K. E. Taeuber, L. L. Bumpass and J. A. Sweet (eds), *Social Demography* (London, 1978).

[25] A more detailed consideration of the immediate post-war years appears in Appendix B of M. Ní Bhrolcháin, 'Period parity progression ratios and birth intervals in England and Wales, 1941–1971', LSHTM CPS Research Paper No. 85–4 (London, 1985).

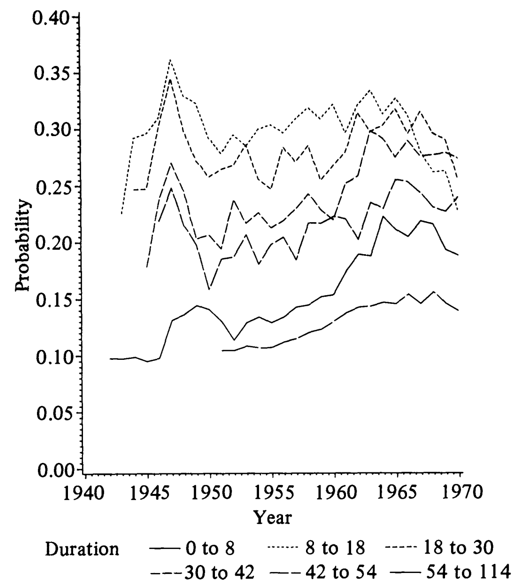

Figure 2A. Conditional first birth probabilities, England and Wales 1941–1970/1.

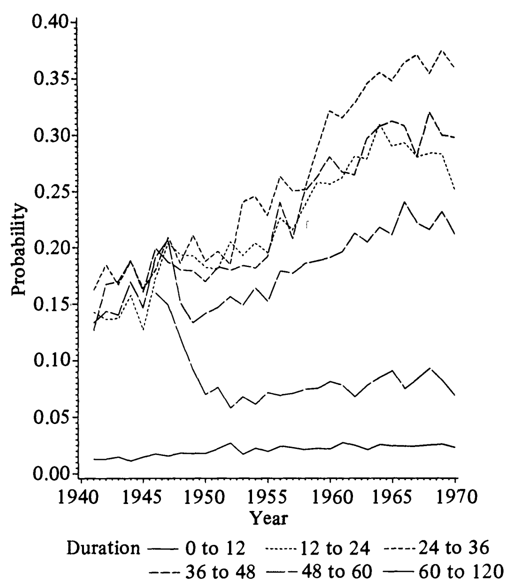

Figure 2B. Conditional second birth probabilities, England and Wales 1941–1970/1.

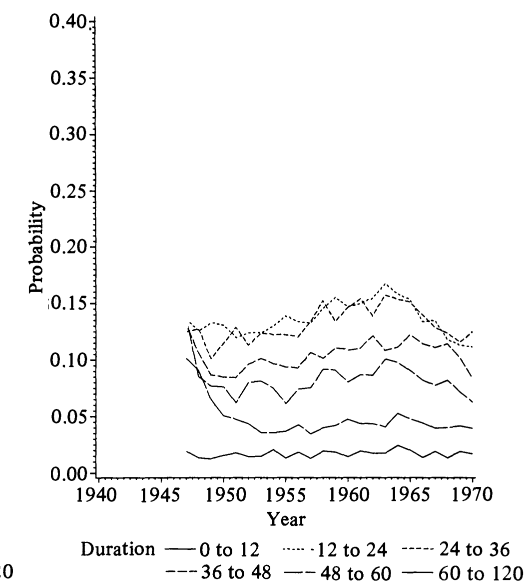

Figure 2C. Conditional third birth probabilities, England and Wales 1941–1970/1.

from the early 1950s the steepest increase in conditional first birth probabilities is at durations below nine months. In 1951–3 the probability of a birth occurring within the first eight months of marriage was 0.124 compared with 0.207 in 1963–5, an increase of 67 per cent. Conditional rates at higher durations increased during that time by between 12 per cent and 33 per cent (Table 2). Fourthly, the behaviour of these conditional first-birth rates by duration begins to diverge during the late 1960s, the rates at early durations declining sharply (by eight per cent between 1963–5 and 1969–70/1 at durations less than nine months, by 25 per cent at durations 9–17 months, and 11 per cent at durations 18–29 months) while the easing in probabilities of first birth is much

Table 2. *Life table conditional probabilities* ($_nq_x$) *of the first to third birth in specified intervals, selected years. England and Wales, 1951–70/1*

				1951–3 to 1963–5		1963–5 to 1969–70/1	
Months	1951–3	1963–5	1969–70/1	Change	Per cent change	Change	Per cent change
Birth 1							
0–8	0.124	0.207	0.191	0.083	+67	−0.016	−8
9–17	0.286	0.325	0.244	0.039	+14	−0.081	−25
18–29	0.273	0.306	0.273	0.032	+12	−0.034	−11
30–41	0.216	0.288	0.277	0.072	+33	−0.011	−4
42–53	0.193	0.241	0.234	0.048	+25	−0.008	−3
54–113	0.105	0.146	0.143	0.041	+39	−0.003	−2
Birth 2							
0–11	0.022	0.024	0.025	0.002	+9	0.001	+1
12–23	0.193	0.293	0.267	0.100	+52	−0.026	−9
24–35	0.207	0.349	0.367	0.142	+69	0.018	+5
36–47	0.182	0.305	0.298	0.123	+68	−0.007	−2
48–59	0.151	0.211	0.222	0.060	+40	0.011	+5
60–119	0.067	0.085	0.082	0.017	+26	−0.003	−4
Birth 3							
0–11	0.015	0.021	0.018	0.006	+38	−0.003	−14
12–23	0.123	0.159	0.112	0.036	+30	−0.047	−30
24–35	0.122	0.154	0.120	0.032	+26	−0.034	−22
36–47	0.094	0.114	0.093	0.020	+21	−0.021	−18
48–59	0.074	0.096	0.067	0.022	+29	−0.029	−30
60–119	0.042	0.049	0.051	0.005	+11	0.002	+3

smaller (between one and four per cent) at higher durations during this period. Fifthly, among the conditional second birth probabilities between the early 1950s and the mid-1960s, the rate of increase was particularly marked at shorter durations, conditional probabilities rising by 52 per cent at duration 12–23 months, by 69 per cent at duration 24–36 months, by 68 per cent at duration 36–47 months, compared with a rise of 40 per cent at duration 48–59 months and of 26 per cent in durations exceeding five years. Finally, apart from the flatness of the probabilities at durations beyond five years compared with the rest, there is less variation by duration in the behaviour of the conditional third birth probabilities: the upward shifts between the early 1950s and the mid-1960s being in the range 21 per cent and 30 per cent between durations 1–2 and 4–5 years, and the subsequent decline ranging between 18 and 30 per cent at these durations.

Like the overall progression ratios, these figures reveal both similarities and divergencies in time trends between and within birth orders. Particularly noteworthy is the strong increase in the probability of a second birth at short durations up to the mid-1960s. The proportions of second births (in the life table) which occur within five years of the first among progressions by ten years rose from 0.81 to 0.90 between 1951–3 and 1969–70/1 (the corresponding rise for first births was from 0.88 to 0.90 and for third, from 0.75 to 0.79).[26] While the rising order- and duration-specific birth rates through the 1950s and into the 1960s are especially marked at short durations, the upward trend is not confined to early durations, as is seen in Table 2.

By analogy with changing age-specific event rates, the differential shifts by duration in the conditional order-specific birth probabilities may be viewed in two ways: either as reflecting an interaction between duration and period on the 'quantum' of duration-controlled rates which then has consequences for the 'timing' of these births (i.e. birth

[26] See Tables 2 and 3 and Figure 2 of Ní Bhrolcháin, 1985, *loc. cit.* in footnote 25 for more detailed results.

Table 3. *Median age at marriage and median birth intervals England and Wales 1941–70/1*

Year	Age at marriage	B_{m1}	B_{12}	B_{23}	B_{34}	B_{45}
1941	22.1	—	41.1	—	—	—
1941	22.0	—	40.2	—	—	—
1943	22.3	—	41.1	—	—	—
1944	22.5	—	41.6	41.8	—	—
1945	22.2	—	43.1	40.7	—	—
1946	22.2	—	41.9	46.9	—	—
1947	22.1	—	37.6	45.1	40.2	—
1948	22.0	—	37.6	43.8	40.1	—
1949	21.9	—	34.2	41.4	41.0	—
1950	21.9	—	34.1	36.2	35.8	—
1951	21.9	19.5	34.4	34.9	36.4	—
1952	21.9	19.7	32.5	36.7	36.6	—
1953	21.8	19.7	32.3	34.6	31.6	—
1954	21.7	18.7	31.2	33.4	37.9	32.9
1955	21.6	19.0	32.7	33.0	30.9	31.7
1956	21.4	19.0	31.2	34.5	32.8	33.9
1957	21.4	18.2	31.5	32.6	31.4	31.9
1958	21.4	17.9	30.7	32.5	32.8	32.4
1959	21.3	18.3	29.3	33.1	34.0	33.8
1960	21.2	17.7	29.4	33.7	31.9	33.2
1961	21.2	18.5	29.0	32.2	31.7	31.2
1962	21.2	17.1	28.2	33.0	34.0	32.3
1963	21.2	16.8	28.3	31.0	33.3	30.1
1964	21.3	16.5	27.0	33.6	33.8	33.9
1965	21.2	16.4	28.4	33.6	35.6	33.2
1966	21.2	17.3	27.7	34.7	37.4	38.2
1967	21.4	17.9	27.7	34.2	33.2	34.8
1968	21.2	18.9	28.4	36.3	34.8	38.7
1969	21.1	19.8	28.0	36.4	36.1	34.4
1970–71	21.3	22.0	29.1	34.5	33.2	35.6

intervals) or as reflecting changing birth intervals: the observed values could arise from either effect (or a combination of both) and these data give no grounds for preferring one perspective over the other. Period estimates of birth intervals are calculated explicitly in the next section.

(C) *Birth intervals*

Birth intervals from the period life table have been summarized by the median duration of occurrence of next birth obtained by confining attention to those who progress to the next birth within ten years. Median age at marriage is estimated similarly for those who marry by exact age 30. Results are given in Table 3. The median age at marriage shows a straightforward drop of 0.8 years from 21.9 in 1951 to 21.1 in 1969. The median first interval shows a small decline from 19.5 months in 1951 to 16.4 at its lowest point in 1964. A segmental median first interval calculated by omitting the first twelve months of marriage did not change at all between 1951–3 and 1963–5, being 27.8 and 27.9 months at these dates. The median among first births occurring within twelve months of marriage fell over this period only from 7.1 to 6.1 months. These figures indicate that the principal contributor to the moderate acceleration in speed of first birth after marriage to the mid-1960s was the greater share among all first births of pre-maritally conceived first births. In contrast to the rather slow drift down to 1965 in the median first interval, there

Table 4. *Interquartile ranges: age at marriage and birth intervals England and Wales 1941–70/1*

Year	Age at marriage (Years)	B_{m1}	B_{12}	B_{23}	B_{34}	B_{45}
1941	4.0	—	45.7	—	—	—
1942	4.0	—	39.5	—	—	—
1943	4.5	—	39.2	—	—	—
1944	4.4	—	39.9	39.3	—	—
1945	4.2	—	40.5	39.4	—	—
1946	4.0	—	40.0	45.1	—	—
1947	4.0	—	38.7	44.3	46.5	—
1948	4.0	—	40.0	47.8	45.3	—
1949	3.9	—	35.1	49.5	49.1	—
1950	3.9	—	32.7	47.4	48.0	—
1951	3.7	29.8	33.6	42.7	44.3	—
1952	3.7	27.7	29.9	38.2	42.0	—
1953	3.8	28.1	28.9	33.2	30.7	—
1954	3.7	28.1	27.9	34.1	38.4	40.3
1955	3.5	29.9	29.3	35.5	35.5	32.1
1956	3.5	28.5	26.4	38.4	35.2	37.2
1957	3.5	27.9	28.1	31.8	39.4	34.9
1958	3.5	26.5	26.8	34.8	39.1	35.4
1959	3.4	29.9	24.6	33.5	37.1	42.6
1960	3.4	29.4	22.8	36.1	41.4	34.0
1961	3.5	28.4	23.9	32.9	34.3	38.2
1962	3.4	25.4	22.8	33.8	41.0	34.5
1963	3.5	26.2	21.8	32.7	38.7	32.7
1964	3.5	26.8	21.7	36.1	35.0	39.0
1965	3.4	25.6	22.7	33.8	36.6	32.3
1966	3.5	27.4	21.2	35.0	43.2	39.6
1967	3.7	27.3	21.7	34.4	40.4	38.6
1968	3.6	29.3	22.2	34.6	43.5	47.3
1969	3.3	29.4	20.8	37.7	42.9	51.0
1970–71	3.8	31.9	20.8	38.1	36.2	46.8

followed a swift increase in the time from marriage to first birth which lengthened by between five and six months during the period 1965–1970/1. This sharp increase continued into the 1970s, vital registration data showing an increase in the median first interval from 20 months in 1971 to 31 months in 1978.[27] The spread of the distribution of intervals between marriage and first birth also diminished during the period under review – the interquartile range contracting by 4.2 months from 29.8 months in 1951 to 25.6 in 1965; like the median itself, the interquartile range also increased again rapidly during the late 1960s – to 31.9 months in 1970/1 (Table 4).

The second birth interval shows greater movement than other intervals during the period under examination. Lengthy intervals, with medians of between 37 and 43 months, are observed in 1945–8 reflecting the postponed births of the war and the resulting high rates at late durations at that time. By 1951–3, the median had fallen to 33.1 months, in 1954–6 to 31.7 months, and from that date the average time to second birth fell steadily, reaching 27.9 months in 1963–5 (5.2 months lower than in 1951–3, a decline of 16 per cent). Even more marked is the contraction in the spread of the second birth interval, which narrowed over the period by 8.7 months – from 30.8 months in 1954–6 to 22.1

[27] M. Britton, 'Recent trends in births', *Population Trends* (1980) pp. 4–8; median intervals in Britton's analysis are obtained as the median of intervals closed in a given year, see also *Birth Statistics 1984, OPCS* Series FM2, No. 11 (London: HMSO, 1985), table 11.3.

months in 1963–5. Unlike the median interval itself, which then rose slightly, the interquartile range shows a small further decline to 20.8 months in 1969–70/1. By the mid-1960s, therefore, second birth intervals had become substantially shorter and much less dispersed than in previous decades, and despite a small increase in their median level in the late 1960s, the spread showed signs of further contraction. The second birth interval appears from these figures to have become an especially homogeneous feature in British fertility behaviour. Reflecting this increase in speed and concentration of second birth is the contrast between the period life table for 1951–3, in which 19 per cent of second births occurred more than five years after the first birth with that for 1969–70/1 in which this figure had halved to ten per cent. The third interval displays a lesser increase in tempo and concentration, while in the fourth interval there is little movement.

As a consequence of these developments the character of British birth interval distributions has changed, particularly that of the second interval. Birth interval distributions implied by the period life table are shown in Table 5 for selected years. While during the early 1950s about one-quarter of first births occurred within the first year of marriage, this figure had risen to one-third by the mid-1960s. The main change in the second birth interval distribution is in the increased concentration of second births between 12 and 35 months after the first, these constituted less than half of second births in 1951 compared with more than three-fifths at the end of the period considered. A proportionate decline occurs in second births at durations exceeding four years. No very substantial alterations are found in the third and fourth birth interval distributions.

(D) *Birth hazard functions*

A graphic summary of these movements is provided by the period life table hazard functions. These are presented in Figure 3, arranged by order, for quinquennial periods. The hazard functions are computed on a monthly basis and have been heavily smoothed, using a procedure provided by the graphics package SAS graph based on a cubic spline. They are considered, therefore, as rather rough-and-ready graphic summaries of the main features of order- and duration-specific fertility rates during the period. Briefly, the features highlighted are as follows: (1) between 1951–5 and 1961–5 the first birth hazard function moves upward with little change in overall shape, (Figure 3A), but in 1966–70 the shape alters substantially, reflecting the sharper fall in rates at early than at late durations during the late 1960s; (2) second birth hazard functions from 1941–5 on are seen in Figure 3B and show clearly the elevated rates at late durations (5+years) during and after the second world war. Through the 1950s and 1960s the disproportionate increase in rates at early durations is evident; (3) comparison of the hazard functions by order within calendar periods reveals (i) that there seem to be three types of interval/distribution: that for first births, second and third and later births and (ii) that the relationship between first and second birth rates by duration changed markedly over the period considered (Figure 3D–F).

(E) *Total fertility*

The period parity progression ratios obtained earlier have been used to construct an alternative to the conventional index of period total fertility by a procedure similar to that followed by both Henry and Feeney.[28] The progression-based computation incorporates the fiction that women experience the series of parity progression ratios

[28] Henry, 1953, *op. cit.* in footnote 2; Feeney, 1985, *loc. cit.* in footnote 5.

Table 5. *Birth interval distributions implied by period life table: selected years, England and Wales 1951–70/1*

	Per cent distribution				
Months	1951	1956	1961	1966	1970/1
Birth 1					
0–11	26.2	28.2	32.3	33.7	29.4
12–23	30.5	29.0	25.2	26.3	22.0
24–35	13.9	14.9	14.5	13.6	16.6
36–47	8.9	9.8	9.9	10.1	11.9
48–59	6.7	6.2	6.2	5.7	7.9
60+	13.8	11.8	12.0	10.5	12.2
Birth 2					
0–11	3.1	3.2	3.4	2.9	2.8
12–23	25.3	29.1	31.6	33.9	30.0
24–35	22.6	26.2	28.0	29.7	32.0
36–47	16.9	17.6	16.3	16.0	17.0
48–59	11.1	10.0	8.7	8.6	8.5
60+	21.1	13.9	12.0	8.9	9.6
Birth 3					
0–11	3.6	3.7	3.6	2.6	3.7
12–23	23.9	26.5	27.1	25.2	23.6
24–35	22.6	20.7	23.6	22.8	23.5
36–47	12.9	14.0	14.4	16.1	13.9
48–59	8.7	10.2	10.1	10.2	9.5
60+	28.3	24.9	21.2	23.1	25.8
Birth 4					
0–11	5.3	3.4	3.6	4.0	4.2
12–23	21.5	28.7	29.8	23.8	27.9
24–35	21.2	22.1	20.2	19.2	20.7
36–47	14.3	15.0	13.1	12.6	14.7
48–59	8.4	7.1	12.8	11.2	8.8
60+	29.4	23.6	20.5	29.2	23.6

observed in a given period. To distinguish it from the conventional age-specific total fertility, the progression-based measure is denoted here by the term 'period completed fertility' (F_p). For comparability with the standard measure, adjustment is made for illegitimacy and marriage and the computation is, for period t,

$$F_{pt} = L_t a_{mt} \sum_{j=0,5} \prod_{i=0,j} a_{it}$$

where L_t is the ratio of total to legitimate births in t, a_{mt} is the progression to marriage by age 30 in t and the a_{it} are as previously defined. The result is plotted in Figure 4 for 1951–70/1 against the conventional age-based measure of total fertility. Throughout, the progression-based total fertility falls short of the age-based index – the period estimate of 'family size' being lower by between 0.21 and 0.29 live births, or by 10–11 per cent. Apart from differences in the data sources and other omissions, it seems likely that the lower level of the progression is due to the fact that the parity progression ratios are not as vulnerable to the effects of shifting tempo is the age-based summation.[29] Over this short period the

[29] Part of the deficit is attributable to the absence of births of seventh and higher orders, births at durations beyond ten years, and marriages at ages over 30, but their contribution is not expected to be large. A comparison of data sources is given in the Appendix.

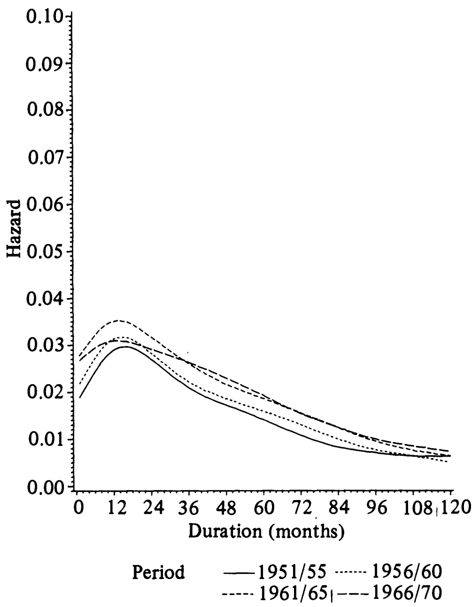

Figure 3A. First birth hazard function, England and Wales 1956–1960.

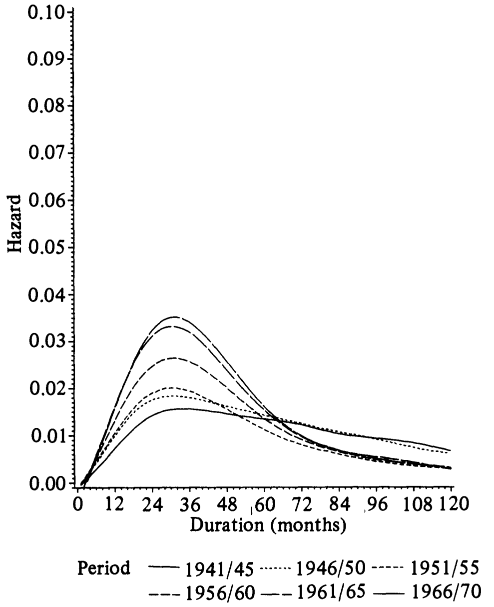

Figure 3B. Second birth hazard function, England and Wales 1941–1970.

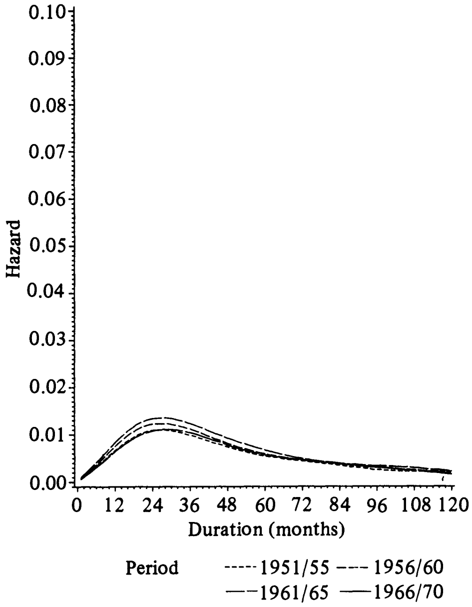

Figure 3C. Third birth hazard function, England and Wales 1951–1970.

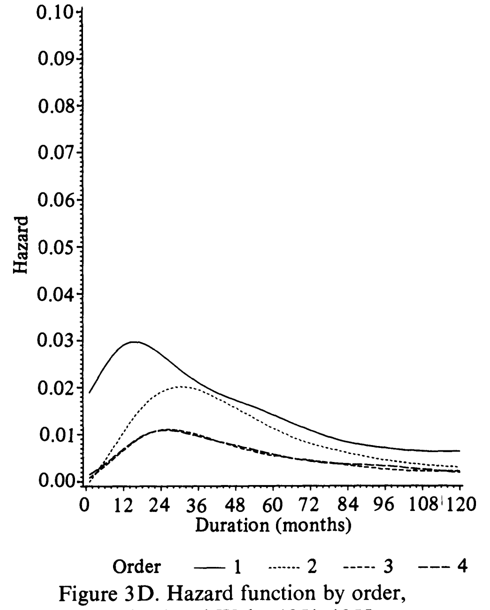

Figure 3D. Hazard function by order, England and Wales 1951–1955.

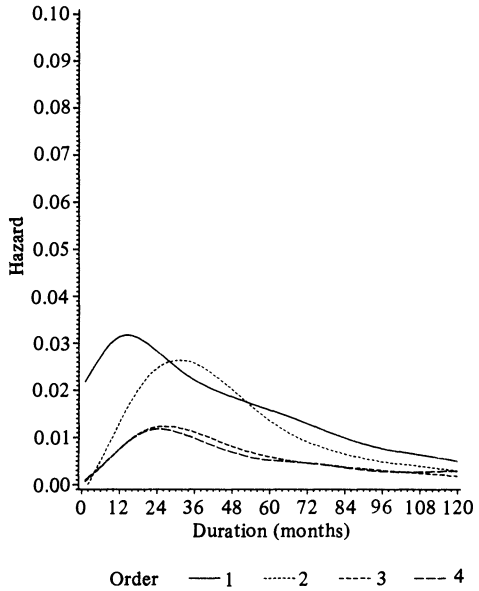

Figure 3E. Hazard function by order, England and Wales 1951–1955.

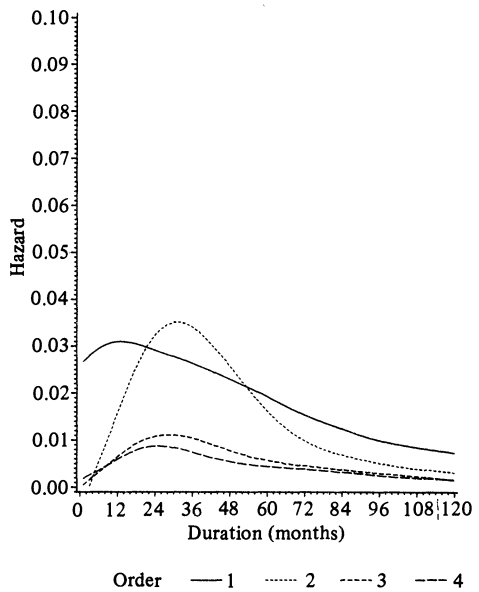

Figure 3F. Hazard function by order, England and Wales 1966–1970.

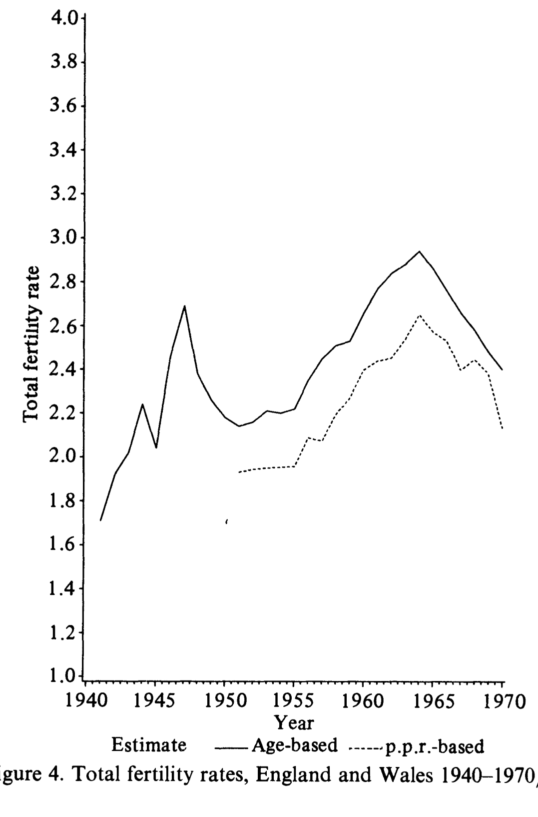

Figure 4. Total fertility rates, England and Wales 1940–1970/1.

movement in both indices is very similar, the proportionate rise and fall being close to identical. However, the relationship between these different period estimates of total fertility in varying circumstances could be complex, and is a matter for further investigation.

(F) *Decomposition*

To draw the findings of this paper together, a decomposition has been carried out to examine the contribution of movements in the progression ratios of different orders to the progression-based measure of total fertility (F_p).[30] The details of the decomposition are given in Appendix B.

The contribution of each individual progression ratio to the deviation of total fertility (F_p) in any year from the average for the period as a whole is represented by the product of the proportionate change in the progression ratio and the mean number of children of that order and above in the standard set of progression ratios. The changes in these components are summarized in Table 6 for seven three-year periods 1950–2 to 1968–70/1. Table 6(A) shows the absolute values of $d_i F_i^*$ per 1000: the interpretation of these figures in the case, for example, of a_1 is that if women were to experience the base-level series of parity progression ratios excepting a_1 , and if a_1 were at its 1950–2 level, the effect would be to reduce average ultimate family size by 161 births per 1,000 women relative to the standard. The computation, as in the entire analysis, is based on the fictitious cohort principle. Evaluated by this means, the figures in Table 6 indicate that throughout most of this period the major source of variation in F_p has been variation in progressions of lower orders (a_0 and a_1) and that those of higher order (a_3, a_4, a_5) play a fairly insignificant role. The major movement is in the component attributable to a_1, with the effect of a_0 being somewhat smaller. Between them, these two account for 81 per cent of the shortfall in F_p in 1950–2 compared with the period as a whole, just over half of the period-based upswing in 1962–4 and around three-quarters of the excess births in 1965–7 above the average for the period (Table 6B). Higher-order progression ratios are prominent, however, in the speed and size of their reduction from the mid-1960s.

6. DISCUSSION

The analyses reported here were undertaken with the aim of providing a more sharply focussed description of trends in fertility in post-war in Britain than can be obtained from vital registration sources, with special emphasis on order-specific fertility.[31] Two phases are distinguishable, corresponding to the initial post-war upswing in fertility to the mid 1960s and to the onset of the subsequent decline in period rates. During the first stage, the findings indicate a general increasing propensity to proceed to births of orders 1–4, if duration is controlled for, together with a rise in the propensity to marry. Associated with this general upward movement in the quantum indicators is a speeding up of the pace of entry into marriage and in the speed of subsequent iintervals. Increases in the progressiion ratios of lower orders dominate the fertility upswing, the expansion in a_0 and a_1 jointly accounting for 50 per cent of the rise in the progression-based total fertility to 1962–4, progression ratios of orders 3 and 4 contributing less than one-third of this increase (Table 6B). After 1964, the similarity of movement of the low- and high-order progression ratios changes, with the third and fourth progression ratios dropping sharply while the probability of marriage, a_0 and a_1 remaining fairly steady until 1969–70. These

[30] The specification of the decomposition carried out here is due to M. J. Murphy.

[31] Parity progression ratios and birth intervals estimated for cohorts from the Census of 1971 are given in E. Grebenik, *Fertility Report from the 1971 Census* (London: HMSO), Series DS, No. 5, 1983.

Table 6. *Absolute and proportionate contribution ratios*

Period	Legitimacy ratio	Marriage	a_0	a_1	a_2	a_3	a_4	a_5	Absolute deviation
(A) Absolute contribution, per 1000 women, of legitimacy ratio, marriage and parity progression ratios to period variation in completed fertility									
1950–2	−28	−61	−85	−161	−21	+22	+18	+11	−0.305
1953–5	−34	−37	−79	−120	−42	−7	+3	+4	−0.311
1956–8	−32	+3	−36	−41	−10	−4	0	−2	−0.124
1959–61	−14	+38	−1	+38	+33	+20	+14	+4	0.131
1962–64	+16	+20	+73	+80	+55	+30	+8	0	0.281
1965–67	+42	+24	+84	+105	+22	−14	−14	−3	0.246
1968–70/1	+52	+12	+41	−94	−41	−51	−3	−11	0.064
(B) Proportionate contribution of legitimacy ratio and each progression (per cent)									
1950–2	−9	−20	−28	−53	−7	+7	+6	+4	
1953–5	−11	−12	−25	−39	−13	−2	+1	+1	
1956–8	−26	+2	−29	−33	−8	−4	0	−2	
1955–61	−11	+29	−1	+29	+25	+15	+11	+3	
1962–64	+6	+7	+26	+28	+19	+11	+3	0	
1965–67	+17	+10	+34	+43	+9	−6	−6	−1	
1968–70/1	+80	+19	+63	+146	−64	−79	−48	−18	

results for England and Wales agree in broad outline with Brass's[32] for the period 1956–80, using an indirect method applied to vital registration data on births by order. The central importance of the low-order progression ratios in accounting for the baby boom in the US has been noted.[33] The period fertility pattern (*a*) pronounced upward movement to the mid-1960s in first and second progression ratios and (*b*) rapid declines from the mid-1960s peak in the ratios of higher orders is also found, from indirect estimates (using Henry's method) of period parity progression ratios, in Belgium, Italy, Norway and the Netherlands[34] and in the application of Brass's indirect method to Italy and France.[35] There are some variations in detail, however, the small increases to the mid-1960s in progressions to third and fourth birth in England and Wales are not found during the early 1960s in the European countries in Marchal and Rabut's or Frinking's analyses, nor do they appear in the application of Brass's method to Italian and French series.

There are three ways of viewing the differential movements in the various orders of progression to the mid-1960s.

(1) First, one may regard each of the progressions individually, and consider that movement in each needs to be separately accounted for – the philosophy underlying the parity progression approach would tend to lead to such a perspective. Explanatory inquiry would then be directed to accounting for the upward movement in the quantum and tempo of parity progression ratios of low orders during the 1950s and into the 1960s and to the sharp decline in the ratios of higher orders from the mid-1960s.

[32] Reported in B. Penhale, 'The course of fertility in France, Italy and England and Wales since 1955', unpublished MSc. dissertation, London School of Hygiene and Tropical Medicine (London, 1984).

[33] See N. B. Ryder, 'The future of American fertility', *Social Problems*, **26** (1979), pp. 359–370; N. B. Ryder, 1980, *loc. cit.* in footnote 1 and L. Isaac, P. Cutright, E. Jackson and W. R. Kelly, 'Period effects of race- and parity-specific birth probabilities of American women, 1917–76: a new measure of fertility', *Social Science Research*, **11** (1982), pp. 176–200.

[34] Marchal and Rabut, 1972 and Frinking, 1976, *loc. cit* in footnote 5.

[35] A. Pellizzi, 'Fertility components. Analysis of period parity progression ratios in Italy, 1955–78', unpublished MSc. dissertation, London School of Hygiene and Tropical Medicine (London, 1982), and Penhale, 1984, *loc. cit.* in footnote 31.

Table 7. *Family size distributions among married women implied by the period parity progression ratios, England and Wales, 1951–70/1*

Family size...	Per cent distribution 0	1	2	3	4+
1951	17	25	30	14	15
1956	14	21	33	17	15
1961	11	17	33	18	21
1966	8	14	37	21	19
1970/71	12	16	39	21	12

I have suggested a possible explanation for the rise in the speed and level of progression to second birth, and to a lesser extent to the first birth,[36] elaborating on an argument by Keyfitz: the view put forward there suggests that the strong upward trend in women's employment during the 1950s and 1960s had a positive impact on period rates. This is because women's economic activity is suggested to have two kinds of effect on fertility – (*a*) a positive and accelerating effect through anticipated future employment and (*b*) a negative, decelerating influence due to current work engagement. The 'work later' effect, it is argued, was dominant during the 1950s and into the 1960s, thus promoting short birth spacing and possibly also an earlier beginning of childbearing. It is suggested that improvements in contraceptive technology have facilitated this process through reducing the (later) risks associated with faster childbearing. This constitutes a possible account of the rise in both level and speed of the second progression and possibly also of the first, and a variety of evidence examined gives substantial support to this view.

It is possible that more basic demographic factors were at work during the 1950s and 1960s to induce speedier completion of birth intervals. In particular, it can be suggested that contraction in both the median and the spread of birth intervals (especially the second) is ascribable to the elimination of long birth intervals resulting from late 'contraceptive failures'. Data from the Family Formation Survey[37] – a nationally representative sample survey carried out by OPCS in 1976 – show that this is not the explanation for the contraction in interval length. First to third intervals initiated in 1956–65 have been examined and show the following: (*a*) intervals closed by a 'contraceptive failure' were typically substantially shorter than those of 'stopped users' and for first and second intervals, shorter than those of non-users,[38] median first intervals were: 'stopped users', 32.2 months; 'contraceptive failures', 12.7 months; and non-users, 16.1 months; corresponding figures for second intervals are 33.9 months, 23.0 months and 26.9 months, and for third intervals 42.0 months, 33.8 months and 29.0 months; (*b*) only a minority of very long intervals (those exceeding five years) are closed by a 'contraceptive failure'; of closed intervals exceeding five years six per cent of first,

[36] M. Ní Bhrolcháin 'Paid work and the tempo of childbearing: longitudinal evidence', LSHTM CPS Research Paper No. 84–3 (London, 1984); M. Ní Bhrolchaín, 'Women's paid work and the timing of births: longitudinal evidence', *European Journal of Population*, **2** (1986), pp. 43–70; M. Ní Bhrolcháin, 'The interpretation and role of work-associated accelerated childbearing in post-war Britain', *European Journal of Population*, **2** (1986), pp. 135–154.

[37] See K. Dunnell, *Family Formation 1976* (London: HMSO, 1979).

[38] The identification of 'contraceptive failure' is difficult in general. The present analysis uses information on whether among ever-users during an interval the couple were 'still using' a method ('contraceptive failure') or had stopped using a method ('stopped users') at the time of conception; non-users in an interval are considered separately. Results are very similar when intervals are classified by respondents' retrospective report of intention – whether or not they were trying to conceive at the time of conception.

17 per cent of second and 35 per cent of third intervals ended with a 'contraceptive failure'; (*c*) if 'contraceptive failures' were eliminated median first intervals would have been three months longer, and second and third intervals approximately 1.5 months longer. The contraction in duration and spread of intervals is, on this evidence, not ascribable to lower contraceptive failure rates, since the interval closed by a 'contraceptive failure' is typically much shorter than average. As is argued above, however, improved contraceptive techniques may have contributed to the greater speed of reproduction through a rather different mechanism. In general, it is likely that socio-economic factors have been operating to change preferences relating to the duration of the childbearing span, and the combination of greater opportunities for married women in the labour force with enhanced fertility control seems so far the most promising explanation.

(2) A second approach is simply to consider the individual parity progression ratios as having been each subject to constraints or natural upper bounds and that the fertility upswing of the 1950s and 1960s reflects no more than the influence of a single general set of factors favourable to fertility; in this perspective a_0, being already high, could only register a small increase, a_1 being of moderate size, being capable of greater movement, and a_2 and a_3, being perhaps constrained within narrower limits, responding rather less to such a positive shock.

(3) A third perspective is provided by examining the completed parity distributions implied by the period parity progression ratios. In Table 7 the synthetic family size distributions for selected years between 1951 and 1970/1 are shown. Substantial declines are seen in childless and one-child families between 1951 and 1966 (from 17 per cent to eight per cent and from 25 per cent to 14 per cent, respectively), substantial increases in families of two and three (from 30 per cent to 37 per cent and from 14 per cent to 21 per cent respectively, between 1951 and 1966) and a smaller rise in larger families. During the late 1960s the synthetic parity distributions show the proportions of two-child families rising further and those of three children to begin a decline, and Brass's results show that both of these features continue into the 1970s. It may be suggested, therefore, that the process of both rise and fall in fertility during the post-war period could be described as being simply a convergence on the two-child family, from families of lower and higher sizes.

While the refinement of measurement offered by the availability of rates specific for order and duration provides a fresh perspective on the nature of the post-war movements in British fertility, we are still left with Ryder's 'conceptual conundrum' – not simply one of accounting for the movements observed but of even arriving at a summarizing verbal description of them: should we view the developments as a generalized rise and fall in fertility, as specialized and particular to each order individually, or the whole as a 'convergence' on a norm? Traces of all three types of process, general, special and systemic, need to be sought and documented, and explanatory frameworks should ideally be closely tied to the detail of fertility change observable by methods of the kind used here.

APPENDIX A

The marriage and maternity histories come from a one per cent sample of women aged 16–59 at 1971 enumerated in the Census of England and Wales of 1971. 143,724 such women are in the sample of whom 112,525 had been ever married. Of all single and ever married women 122,644 (85 per cent) were used in the marriage analysis. (Table A 1) The unavailability of marriage date before 1941 resulted in the loss (to the analysis of marriage and first birth) of 17,366 cases (12 per cent), in a further three per cent of cases the date of marriage was missing. Any woman (*a*)

Table A 1. *Sample numbers*

N	Per cent	
MARRIAGES		
143,724	100	Total women aged 16–59
17,336	12	Married before January 1941
3,774	3	Marriage date missing
122,644	85	Cases used
BIRTHS		
112,525	100	Total ever married women aged 16–59
6,294	6	Missing date of marriage or of any birth of orders 1–6
3,684	4	Either dates of birth inconsistent or marriage prior to 1941 and no live birth
102,547	91	Cases used

Table A 2. *Comparison of vital registration and census-based marital general fertility rates (legitimate births per 1000 married women aged 15–44)*

	Vital registration	Census per cent sample	Ratio Census/VR
1957	111.7	108.1	0.97
1958	114.3	112.8	0.99
1959	115.4	114.3	0.99
1960	120.8	118.7	0.98
1961	123.8	121.2	0.98
1962	126.1	121.3	0.96
1963	126.9	124.1	0.98
1964	128.7	128.3	1.00
1965	126.9	124.9	0.98
1966	124.8	122.7	0.98
1967	121.5	120.0	0.99
1968	119.2	118.7	1.00
1969	115.8	117.0	1.01

whose date of marriage was missing or with a missing date of birth of any order up to the sixth or (*b*) whose maternity history included inconsistent dates or (*c*) whose marriage occurred before 1941 and who had not had a live birth was excluded entirely from the life tables for birth intervals. These amounted altogether to nine per cent of the 112,525 ever married women, giving 102,547 cases included in the analysis of at least one interval.

There are minor divergencies in the populations answering the one per cent retrospective census question, and events recorded in the England and Wales vital registration system over this period. The former includes births to women abroad, excludes those to emigrants, and is based on survivors at 1971. There are various other factors which lead to a lack of exact correspondence between events recorded in the two sources. However, the major divergence for births from 1951 onwards is due to the following factors: (i) the rejection in the present analysis of ever-married women with defective records; (ii) the decision to restrict the analysis to births of orders below the seventh; and (iii) the decision to restrict attention to births that occurred within ten years of the previous birth (or first marriage in the case of first birth).

The first of these is the most important, accounting for around ten per cent of ever-married women. Another possible problem is omission by women of births (overstatement being unlikely). Within the divergencies of the two sources it seems likely that the number of births to ever-married women under the age of 45, divided by the number of ever-married women of that age (i.e. a legitimate GFR based on the census maternity histories) should approximate to the legitimate general fertility rate from vital statistics. Since the one per cent sample only contains the full age range up to exact age 45 from 1957, results from this point only onwards are shown in Table A2. It is seen that the agreement between the two sources is very close. It seems reasonable to conclude therefore that the discrepancies between the conventional measure of total fertility and the progression-based total fertility (Section 5E) is unlikely to have been caused by underrecording of births in the one per cent sample over this period.

APPENDIX B: DECOMPOSITION OF PROGRESSION-BASED TOTAL FERTILITY

Let F_p^* be the base level total fertility computed as

$$F_p^* = L^* a_m^* \sum_{j=0,\,5} \prod_{i=0,\,5} a_{it}^*.$$

The base level F_p^* and other indices have been set here equal to the arithmetic mean of their values over the 21 years 1950–70/1. The a_{it} (progression ratio of order i in year $t, i=0,5$ and $i=m$ for marriage) are then expressed as

$$a_{it} = (1+d_{it})\, a_i^*$$

The estimate of F_p in t is

$$F_{p,t} = L^* a_m^* (1+d_{Lt})(1+d_{mt}) \sum_{j=0}^{5} \prod_{i=0}^{j} a_i^* (1+d_{it}).$$

On expansion this expression becomes

$$F_{p,t} = F_p^* + d_{Lt} F_p^* + d_{mt} F_p^* + d_{0t} F_p^* + d_{1t} F_1^* + d_{2t} F_2^* + d_{3t} F_3^* + d_{4t} F_4^* + d_{5t} F_5^* + \text{terms involving } d_i\, d_j,$$

where

$$F_k^* = L^* a^* \sum^{5} \prod^{j} a_{it}^*,$$

that is, F_k^* is the mean number of births of order $k+1$ and above occurring in the base set of progression ratios. Thus the difference between F_{pt} and F_p^* is

$$F_{pt} - F_p^* = d_{Lt} F_p^* + d_{mt} PF^* + d_{0t} F_p^* + \sum_{k=1}^{5} d_{kt} F_k^* + \text{terms involving } d_i\, d_j$$

The approximation to actual values of F_p obtained by ignoring second-order terms is very close, the error being below 1.5 per cent each year in 1950–70/1. The decomposition may, therefore, be represented without these terms. The components of the trend in the progression-based F_p may be represented by means of the individual terms involving the d_{it} in the expression for $F_{pt} - F_p^*$: $d_{mt} F_p^*$ being the component of the annual variation in the synthetic family size measure attributable to marriage, $d_{0t} F_p^*$ representing the effect of a_0, $d_{1t} F_1^*$ that of the second progression and so on.